Title
Practice effects in the performance of a simple visual discrimination task by initially naive observers

Author
Taylor, John H

Publication Date
1962-10-01

PRACTICE EFFECTS IN THE PERFORMANCE OF A SIMPLE VISUAL DISCRIMINATION TASK BY INITIALLY NAIVE OBSERVERS

John H. Taylor

October 1962
SIO Reference 62-21

BuShips Contract NObs-84075
Project S F018 02 01
Task 0538

SUMMARY

An experiment was conducted to evaluate the effects of early practice during training in a simple visual discrimination task. Four experimentally naive subjects completed a series of fifty experimental sessions, and their data, based upon threshold estimates reduced from 50,000 observations, were examined for both short-term and long-term practice effects. Short-term effects were found to be limited to very early sessions, with essential stability of sensitivity having been reached by the fifth session. This result is consonant with other studies of training effects in the visual domain. Long term effects, up to the fiftieth session at least, were not found. It has been concluded that naive observers may confidently be assumed to have attained a stable level of performance after very few training sessions in tasks requiring a simple discrimination.

PRACTICE EFFECTS IN THE PERFORMANCE OF A SIMPLE VISUAL DISCRIMINATION TASK BY INITIALLY NAIVE OBSERVERS

John H. Taylor

INTRODUCTION

A matter of continuing concern in experimental studies of human visual performance is the extent to which practice or learning effects influence the results. These effects are likely to be important at two different stages of laboratory experimentation. The first of these stages is the one at which new, wholly unpracticed and usually experimentally naive observers are brought into the laboratory to serve as subjects. The second concerns the shift of experimentally experienced, perhaps highly practiced, observers to a novel set of stimulus conditions. The former problem is the subject of this paper.

It has become accepted procedure in experimental visual psychophysics in which we seek to investigate the influence of various physically defined parameters of the stimulus situation, to try to employ observers in small numbers and for extended periods of time (months or years) rather than to use very large numbers of observers for brief periods (e.g., a few experimental sessions). In this way, it is evident that the subjects may become highly practiced in the experimental task, and, further, that over a long series of experiments a great deal of information about their performance can be amassed for purposes of inter-task comparisons. The highly practiced observer becomes, after a time, a sensitive meter for the assessment of the importance of a chosen stimulus variable. This is especially true if the psychophysical method used is one of demonstrated reliability and validity.

The present study was undertaken in order to examine the time course of practice effects during training of observers for subsequent use in a series of ongoing experiments. It was anticipated that these experiments might continue for as long as two years, and the question to be answered was: At what time in the early history of the observers may their performance be considered to have become stable in terms of freedom from further variability ascribable to learning or practice? The practical importance of this question is clear, for an overly conservative approach leads to wasteful rejection of data, while an incautious acceptance of data contaminated by practice effects leads either to wrong answers or to wasteful repetition of experiments.

PROCEDURE

Subjects -- Four observers were used in the experiment. Three of these were undergraduate male emmetropes without any previous experience in laboratory observation; the fourth was a young female graduate student with a moderate myopia corrected by corneal contact lenses, and without experience in the type of task used here. All subjects exhibited 20/20 vision or better when tested with the Bausch and Lomb Orthorater and with standard letter charts. Each observer completed fifty experimental runs, although the order and spacing of these runs were commonly different owing to scheduling necessities.

Apparatus -- The experimental arrangements may best be described with the help of Figure 1. The observers were comfortably seated in four theater chairs which faced the open side of an integrating "cube" (actually a right rectangular prism 102" wide x 85" high x 74" deep). The interior opposite wall of the cube was uniformly illuminated by tungsten lamps evenly spaced in troffers formed in the edges of the proximal wall and hidden from the observers' view. Centered on the opposite wall, which provided the effective background for the targets, was stretched a sheet of thin translucent milk plastic, selected for its ability to transmit target images without appreciable loss of edge definition and its neutrality as regards spectral transmission and reflection, and treated by a wet-spray abrasive technique to eliminate gloss. This plastic area was circular and 54" in diameter. The average viewing distance, eye to screen, was 124", and each observer always occupied the same seat. The right arms of the chairs were provided with response boxes bearing a set of four pushbuttons.

In the room behind the background screen a target projector with its associated shutters and filters was used to control the time of occurrence, the duration, and the intensity of a light beam which fell upon the rear surface of the plastic. A knife-edged aperture mask in contact with the plastic controlled the target size and shape; in this case a circle of 4.33" diameter. The optics of the projector permitted the target area to be uniformly illuminated, so that the observers were presented with a stimulus which was a positive increment on the background. The target location was invariant, and four small luminous

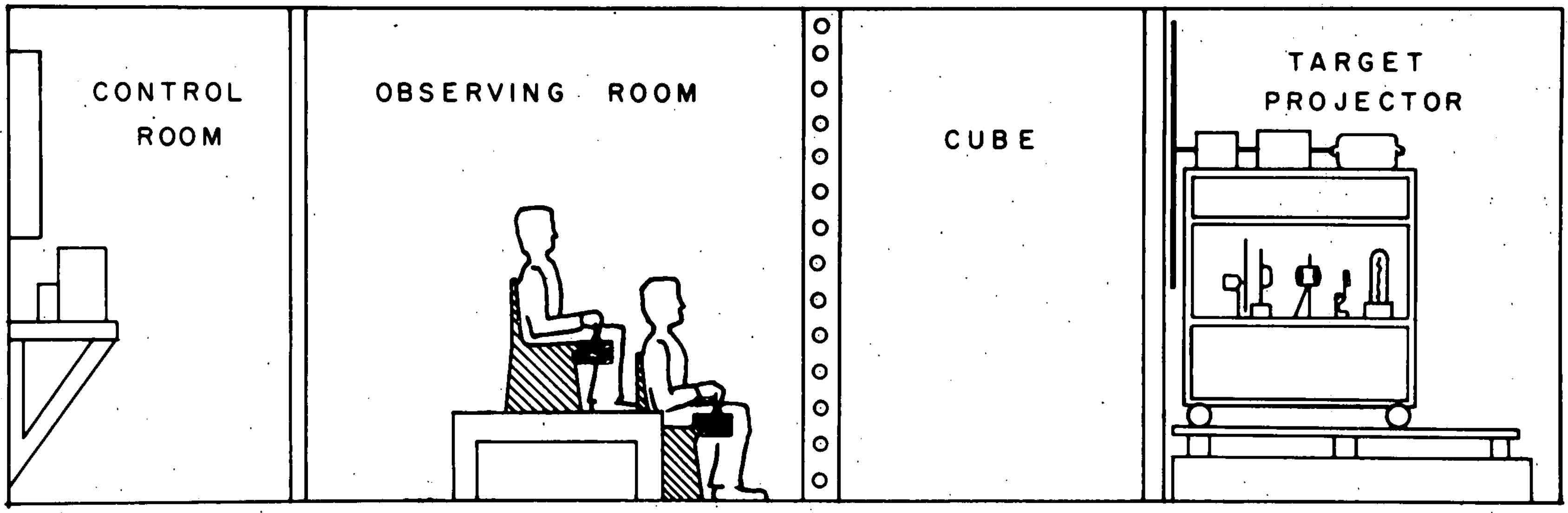

FIGURE 1

Sketch of the experimental rooms, showing control room containing automatic presentation and recording equipment, observing room for four subjects, flux integrating cube for producing a uniform background luminance, and projection room for generation of transilluminated targets points (10 x threshold) were arranged in a diamond pattern around the stimulus area in order to provide accommodation and convergence information. The remaining experimental space, behind the observers, contained the automatic programming and recording apparatus which controlled the timing of the experiment, the intensity of the stimuli, the correct-answer information, and which recorded the responses of the observers. A complete description of an apparatus similar to this may be found in Blackwell et al. (1954).

Photometry -- The luminance of the background screen was measured before and after each experimental session by means of a Macbeth illuminometer, calibrated against secondary standard lamps certified by the U. S. Bureau of Standards at color temperature 2364°K. Simce the apparent color temperature of the illuminometer field, the background screen, and the transilluminated target were all set to this same value, optimum homochromatic photometry was possible. The target luminance was measured at full output, i.e., without any attenuating filters placed in the projector beam. The filters were 4 x 4" Wratten neutrals mounted in glass, and calibrated on the optical bench using a flux geometry similar to that of the projection system. All background and target sources were operated from a regulated power supply, and the use of a heavy tungsten ribbon filament lamp of high current density in the projector served effectively to obviate problems in the use of alternating current.

Target characteristics -- For the entire series of sessions, the target characteristics remained the same. It appeared as a uniformly bright, circular luminance increment centered on the screen. Its duration was always 0.33 second, with an essentially square-wave form. The angular diameter subtended at the average viewing distance was 2°, although differences in eye-to-screen distances for the four observers resulted in corresponding differences in the target subtense. The background was always approximately 10 ft-L, with only minor variations from this value occurring from session to session.

Psychophysical method -- The temporal forced-choice method of constant stimuli was used throughout the study. The details of this method, with an account of its various advantages over other experimental procedures may be found in Blackwell (1953), and elsewhere. In brief, the observer is required to regard the screen during a series of four audibly marked short time intervals. On each trial one, and only one, of these intervals contains a target. At the conclusion of the set of four intervals the observer is required to guess, and to indicate by depressing one of the response buttons, which interval contained the target. In the program configuration used here, one such set (trial) occurred every 14 seconds. A single sub-experiment comprised data from 250 such trials for each observer, and required a little over an hour for completion, allowing for short rest periods at the end of each 50 trials.

Instructions to the observers at the commencement of the study were kept neutral as regarded the method, but they were made aware of the purpose of the experiment in general terms. No special motivation was attempted beyond an implied one based upon the suggestion that subsequent studies would be of importance to the national defense effort. Knowledge of results was both immediate (correct answers on individual trials were privately indicated by small, shielded red lights visible only to the observer in question), and general in the sense that the course of the experiment was freely discussed and the data were handled by the observers during non-observing periods.

During each experimental session the unattenuated target luminance was first reduced, by means of filters which remained in the projection system throughout the session, to a level which previous studies had shown to be barely visible under the conditions of our experiment. This level, at which the target flash will be seen almost 100 per cent of the time provided the easiest target luminance. Four other levels, of increasing difficulty, were provided by a series of filters which could be interposed in the projector beam; these having been chosen so that the densest filter resulted in observer performance at chance levels ($p=.25$). Thus the threshold range, that small region of the physical stimulus intensity continuum over which the frequency-of-seeing function decreases from "always seen" to "never seen", was sampled at five points. These five intensities were randomized in groups of ten trials each, a procedure adopted for reasons given by Blackwell (1952, 1953). The occurrence of the stimulus within the four temporal intervals of a trial was random from trial to trial, with the restriction than each of the intervals be equally represented in each 500 presentations.

Form and reduction of data -- The raw data output consisted of the numbers of occurrences of correct responses at each of five difficulty levels. In the typical case, since each level was presented 50 times in a single session, these numbers might be distributed as in Table I.

Table I

Difficulty level	1	2	3	4	5
Correct responses	50	43	24	18	13

Provided that the selection of the fixed filters in the projector has been satisfactory, it is clear that these frequencies provide the basis for estimating the psychometric function, and hence for the estimate of the conventional threshold at which detection will occur 50 percent of the time. In practice, the obtained frequencies are first corrected for chance successes, and then fitted by normal Gaussian ogives using a method of fractile analysis.[1] In their final form, the data are expressed in terms of luminance contrast, conventionally defined as the ratio of the luminance increment required for a seeing frequency of 50 percent to the luminance of the background. In the present report, however, since the primary concern is with

1. The fractile analytic procedure used here derives from a modification and extension of the probit analytic method described by Richardson (1960). The fractile technique will be described in a forthcoming report from this laboratory: Richardson and Taylor (1962).

the effects of practice, we have converted the data on each individual session to a percentage of the average obtained contrast values in order that we may combine data from four observers into an average practice curve.

RESULTS

Complete data from the experiment are presented in Table II, which shows the results from each of the 200 individual sessions in the following terms:

C_t --- The value of contrast for (corrected) p = 0.50

σ --- The standard deviation of the computed distribution

σ_t --- The standard deviation of C_t

σ_σ --- The standard deviation of σ

X^2 --- The value of Chi-square

σ/t --- The coefficient of variation.

Chi-square values, which indicate the goodness of fit of the data to the ogive, show 70 percent of the curves to have been fitted at the 0.05 confidence level or better, and 83 per cent at the 0.01 level. In seven instances, indicated by asterisks in the table, the data were so aberrant that they were omitted from all subsequent analyses.

In order to facilitate intercomparison between data from the four observers, the values of C_t for each were converted into proportions of his average threshold contrast.[2] This conversion serves to eliminate individual differences in the data arising from differences

2. This average value was computed from the last 45 sessions only.

Run No.	C_t	σ	σ_t	σ_σ	X^2	σ/t
1	.0112	.00416	.00049	.00051	3.447	.372
2	.00713	.00160	.00024	.00021	0.261	.224
3	.00597	.00269	.00029	.00030	0.694	.450
4	.00543	.00193	.00222	.00199	4.358	.356
5	.00663	.00199	.00023	.00020	4.930	.299
6	.00623	.00265	.00027	.00026	14.270	.425
7	.00625	.00192	.00023	.00019	4.030	.308
8	.00541	.00301	.00028	.00033	10.826	.557
9	.00593	.00254	.00026	.00026	13.092	.429
10	.00678	.00231	.00025	.00023	15.579	.341
11	.00671	.00221	.00025	.00022	1.893	.330
12	.00655	.00244	.00026	.00024	8.185	.373
13	.00695	.00370	.00035	.00042	4.651	.532
14	.00685	.00175	.00022	.00018	1.833	.255
15	.00651	.00279	.00029	.00032	4.688	.429
16	.00615	.00255	.00026	.00028	7.377	.414
17	.00564	.00233	.00024	.00024	7.004	.412
18	.00608	.00228	.00024	.00024	6.259	.374
19	.00587	.00255	.00026	.00028	1.697	.434
20	.00648	.00266	.00029	.00032	5.653	.410
21	.00465	.00290	.00026	.00035	1.755	.624
22	.00607	.00242	.00027	.00029	8.186	.399
23	.00693	.00300	.00040	.00043	13.052	.433
24	.00689	.00345	.00039	.00047	3.909	.501
25	.00595	.00261	.00026	.00026	10.705	.438
26	.0142	.0184	.00437	.00912	23.984	1.298*
27	.00723	.00243	.00026	.00025	1.436	.336
28	.00570	.00220	.00023	.00022	3.442	.386
29	.00668	.00310	.00030	.00033	0.770	.464
30	.00561	.00229	.00024	.00023	3.806	.408
31	.00530	.00242	.00024	.00024	10.402	.457
32	.00488	.00232	.00024	.00024	5.963	.475
33	.00556	.00161	.00021	.00017	1.964	.289
34	.00610	.00194	.00022	.00019	1.024	.317
35	.00549	.00166	.00021	.00019	0.529	.303
36	.00475	.00190	.00021	.00019	10.830	.399
37	.00574	.00270	.00026	.00028	3.811	.470
38	.00464	.00212	.00021	.00022	1.439	.457
39	.00584	.00333	.00031	.00036	4.745	.570
40	.00556	.00231	.00024	.00023	3.691	.416
41	.00454	.00188	.00021	.00023	7.706	.416
42	.00604	.00263	.00028	.00028	2.562	.435
43	.00540	.00183	.00021	.00019	3.889	.339
42	.00576	.00165	.00022	.00018	1.258	.286
43	.00507	.00262	.00027	.00029	1.456	.518
44	.00601	.00312	.00030	.00033	0.531	.519
45	.00607	.00212	.00024	.00021	3.403	.349
46	.00626	.00227	.00025	.00022	4.960	.363
47	.00635	.00260	.00027	.00026	2.037	.410
50	.00633	.00288	.00028	.00030	19.857	.456

Run No.	C_t	σ	σ_t	σ_σ	X^2	σ/t
1	.0114	.00478	.00053	.00056	3.390	.421
2	.00844	.00358	.00036	.00036	4.070	.424
3	.00620	.00331	.00033	.00036	1.865	.533
4	.00569	.00236	.00025	.00024	3.405	.416
5	.00484	.00245	.00025	.00027	0.347	.506
6	.0138	.00996	.00243	.00295	53.824	.720*
7	.00608	.00649	.00054	.00116	20.464	1.067
8	.00476	.00202	.00022	.00021	0.078	.424
9	.00546	.00173	.00022	.00019	1.625	.316
10	.00527	.00237	.00025	.00025	8.147	.450
11	.00425	.00305	.00029	.00036	2.192	.718
12	.00446	.00285	.00028	.00033	8.472	.638
13	.00444	.00152	.00019	.00019	1.534	.341
14	.00504	.00277	.00027	.00030	1.436	.549
15	.00694	.00392	.00043	.00056	10.540	.564
16	.00475	.00192	.00020	.00019	8.195	.403
17	.00422	.00197	.00020	.00021	5.174	.466
18	.00455	.00240	.00024	.00026	5.075	.526
19	.00509	.00184	.00020	.00018	2.403	.362
20	.00452	.00241	.00023	.00026	3.492	.533
21	.00488	.00226	.00022	.00023	1.640	.463
22	.00562	.00246	.00025	.00028	5.213	.438
23	.00537	.00251	.00025	.00029	8.050	.467
24	.00532	.00145	.00017	.00015	0.455	.273
25	.00641	.00288	.00030	.00035	5.038	.450
26	.00478	.00221	.00023	.00024	9.313	.463
27	.00510	.00209	.00023	.00022	12.029	.410
28	.00595	.00227	.00024	.00022	3.320	.381
29	.00512	.00250	.00025	.00026	7.177	.488
30	.00573	.00287	.00028	.00030	1.492	.502
31	.00397	.00172	.00019	.00021	7.369	.434
32	.00585	.00212	.00023	.00021	2.320	.362
33	.00501	.00198	.00022	.00021	1.183	.395
34	.00481	.00212	.00023	.00023	2.293	.442
35	.00472	.00216	.00022	.00023	3.874	.459
36	.00819	.0103	.00089	.00240	60.900	1.256*
37	.00491	.00215	.00022	.00022	6.264	.437
38	.00472	.00234	.00023	.00024	4.647	.497
39	.00494	.00241	.00025	.00027	0.611	.487
40	.00367	.00127	.00016	.00016	1.293	.346
41	.00462	.00187	.00020	.00019	5.255	.405
42	.00501	.00224	.00023	.00023	4.121	.448
43	.00392	.00156	.00017	.00016	108.848	.398
44	.00400	.00208	.00023	.00027	10.060	.521
45	.00475	.00291	.00032	.00041	0.401	.613
46	.00507	.00256	.00027	.00030	5.139	.505
47	.00406	.00224	.00024	.00028	3.624	.552
48	.00446	.00252	.00026	.00030	4.126	.565
49	.00565	.00221	.00025	.00023	6.576	.391
50	.00450	.00263	.00026	.00030	3.135	.585

Run No.	C_t	σ	σ_t	σ_σ	χ^2	σ/t
1	.0108	.00695	.00069	.00082	8.441	.645
2	.00747	.00299	.00032	.00030	21.232	.401
3	.00687	.00211	.00027	.00023	3.749	.307
4	.00087	.0108	.00165	.00321	55.513	12.388*
5	.00725	.00280	.00029	.00030	6.338	.386
6	.00714	.00221	.00025	.00022	1.945	.309
7	.00597	.0100	.00081	.00267	77.103	1.676
8	.00520	.00271	.00026	.00028	8.662	.521
9	.00546	.00271	.00027	.00028	9.892	.497
10	.00605	.00315	.00030	.00033	1.338	.520
11	.0118	.0137	.00243	.00504	12.626	1.160*
12	.00554	.00214	.00023	.00022	0.775	.387
13	.00521	.00190	.00022	.00021	4.792	.365
14	.00630	.00270	.00028	.00030	11.624	.423
15	.00556	.00208	.00022	.00021	5.926	.373
16	.00580	.00226	.00023	.00024	10.278	.390
17	.00579	.00285	.00028	.00033	2.241	.493
18	.00553	.00235	.00024	.00026	4.916	.424
19	.00489	.00256	.00024	.00029	25.706	.524
20	.00545	.00156	.00018	.00016	10.878	.285
21	.00596	.00185	.00022	.00019	0.377	.310
22	.00635	.00298	.00029	.00031	6.696	.469
23	.00575	.00364	.00032	.00043	8.098	.632
24	.00585	.00187	.00022	.00019	4.080	.320
25	.00600	.00226	.00024	.00022	2.007	.376
26	.00584	.00216	.00023	.00021	2.291	.370
27	.00591	.00299	.00028	.00032	3.595	.506
28	.00498	.00252	.00025	.00027	2.154	.506
29	.00653	.00331	.00032	.00037	2.453	.506
30	.00598	.00220	.00025	.00024	11.809	.367
31	.00529	.00210	.00022	.00021	3.756	.396
32	.00541	.00228	.00024	.00023	3.957	.421
33	.00530	.00271	.00027	.00029	1.552	.512
34	.00611	.00262	.00027	.00026	0.218	.429
35	.00563	.00278	.00027	.00030	12.764	.494
36	.00492	.00192	.00022	.00022	0.332	.391
37	.00507	.00296	.00032	.00040	0.053	.584
38	.00669	.00298	.00031	.00030	4.002	.446
39	.00515	.00292	.00028	.00032	2.715	.566
40	.00520	.00218	.00025	.00025	1.466	.419
41	.00780	.00433	.00043	.00056	8.439	.555
42	.00632	.00311	.00030	.00033	6.163	.492
43	.00574	.00324	.00030	.00035	3.250	.564
44	.00559	.00279	.00027	.00029	1.862	.499
45	.00594	.00225	.00024	.00022	6.708	.378
46	.00553	.00299	.00028	.00032	2.923	.541
47	.00481	.00184	.00019	.00019	3.634	.382
48	.00473	.00281	.00029	.00034	6.005	.595
49	.00511	.00308	.00031	.00035	5.872	.604
50	.00573	.00298	.00029	.00032	4.748	.521

Run No.	C_t	σ	σ_t	σ_σ	X^2	σ/t
1	.0115	.00473	.00053	.00055	5.459	.411
2	.00737	.00454	.00041	.00052	310.504	.616
3	.00817	.00234	.00029	.00023	4.787	.286
4	.00771	.00251	.00028	.00026	5.000	.325
5	.00806	.00290	.00033	.00033	8.998	.360
6	.00885	.00331	.00039	.00041	8.359	.374
7	.00827	.00323	.00036	.00037	9.907	.390
8	.00753	.00308	.00033	.00035	1.648	.409
9	.00786	.00326	.00033	.00035	6.565	.414
10	.00893	.00347	.00040	.00042	5.031	.388
11	.00851	.00356	.00040	.00044	18.788	.419
12	.00900	.00257	.00031	.00032	7.443	.286
13	.00813	.00342	.00036	.00039	11.772	.420
14	.0108	.00645	.00098	.00121	13.735	.597
15	.00732	.00324	.00040	.00045	15.284	.443
16	.00792	.00354	.00037	.00041	5.548	.447
17	.00731	.00395	.00039	.00050	3.615	.540
18	.00888	.00237	.00029	.00030	0.691	.267
19	.00870	.00374	.00047	.00051	13.401	.430
20	.00765	.00409	.00041	.00053	9.876	.534
21	.00978	.00661	.00100	.00137	11.612	.676
22	.00851	.00245	.00029	.00029	0.307	.288
23	.00988	.00338	.00038	.00038	4.068	.343
24	.00792	.00294	.00033	.00034	1.587	.372
25	.00691	.00277	.00029	.00027	1.179	.401
26	.00767	.00202	.00025	.00021	1.728	.263
27	.00732	.00214	.00025	.00024	7.154	.292
28	.00745	.00272	.00042	.00041	3.437	.365
29	.00657	.00307	.00274		10.574	.467
30	.0123	.00569	.00095	.00098	98.187	.464*
31	.00789	.00283	.00031	.00028	15.151	.359
32	.00625	.00204	.00023	.00020	2.056	.327
33	.00753	.00235	.00026	.00023	4.909	.312
34	.00662	.00245	.00027	.00024	13.142	.370
35	.00849	.00244	.00028	.00027	0.675	.288
36	.00783	.00280	.00030	.00029	8.781	.358
37	.0071	.00219	.00025	.00022	12.068	.305
38	.00684	.00293	.00029	.00030	4.099	.429
9	.00690	.00327	.00032	.00035	1.091	.474
40	.00843	.00379	.00040	.00045	12.232	.450
41	.00867	.00335	.00038	.00040	11.506	.387
42	.00908	.00421	.00053	.00060	3.865	.464
43	.00816	.00345	.00039	.00042	3.439	.423
44	.00800	.00341	.00041	.00045	9.643	.427
45	.00767	.00276	.00029	.00028	6.429	.360
46	.00941	.00449	.00081	.00082	11.589	.477
47	.00802	.00281	.00030	.00028	1.642	.350
48	.0543	.0748	.0852	.1339	60.831	1.378*
49	.00833	.00381	.00039	.00043	19.070	.457
50	.00939	.00401	.00044	.00049	1.178	.427

in sensitivity, as well as from different seating positions. Figure 2 shows the average obtained values of relative threshold contrast as a function of the serial numbers of the experimental sessions. The continuous curve is a purely arbitrary one, brought to an asymptote at the average value obtained on sessions 6 through 50.

Because this experiment concerned a single visual target situation, with background luminance, target size, and target duration held constant throughout 50,000 observations, the data provide a unique opportunity for an evaluation of quotidian variability. Figure 3 shows the obtained values of relative threshold contrast as a function of day of the week. It should be noted, however, that the points on this curve are not defined by equal numbers of sessions.

DISCUSSION

The data of Figure 2 show that the terminal contrast threshold level was reached after very few sessions. From inspection of the data it is evident that no further practice effects are discernable; that is, long term effects, if present at all, are so small as to be obscured by session-to-session variability.

The existence of practice effects during training of naive observers has been noted by experimenters for some time, and a good review of the literature until 1953 may be found in Gibson (1953). By and large, however, the available data have been obtained by psychophysical methods other than the forced-choice method of constant stimuli. Nevertheless, there is general agreement

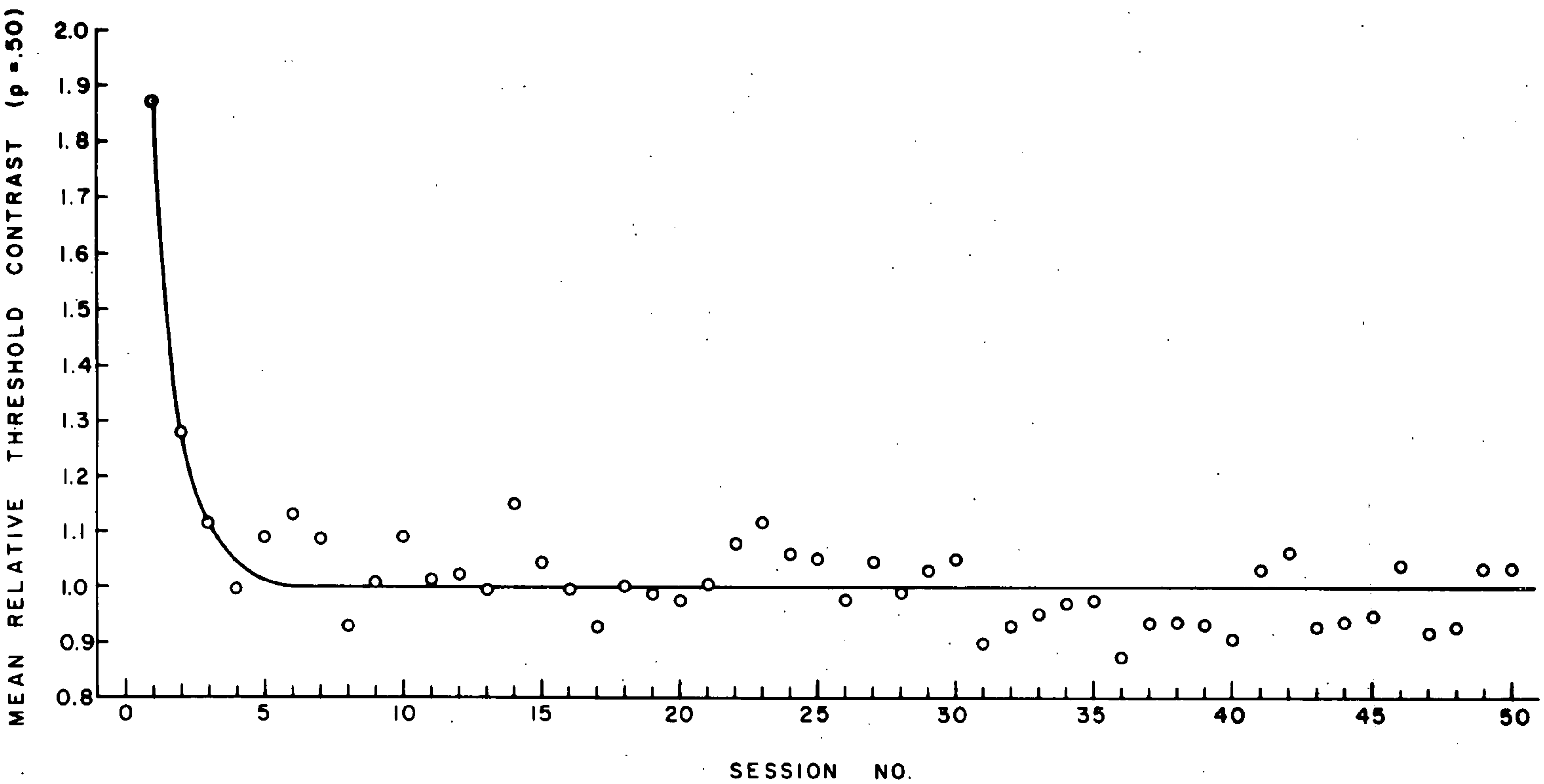

FIGURE 2

Average practice curve from four initially naive observers over fifty experimental sessions; with Background luminance = 10 ft-L, Target = 2° positive circle, Target duration = 0.33 sec

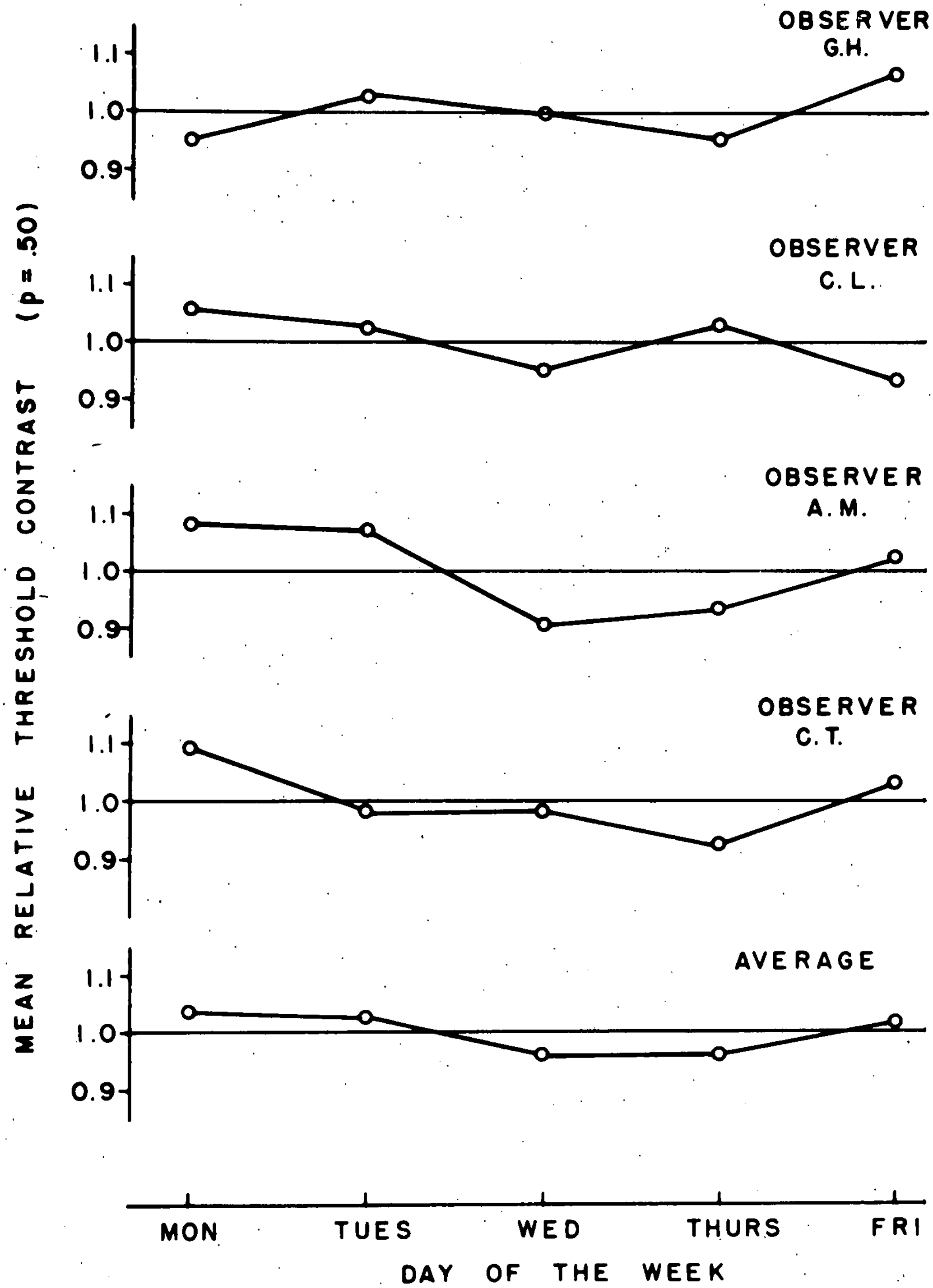

FIGURE 3

Relative values of obtained threshold contrast as a function of the day of the week that practice effects in simple discrimination tasks are insignificant after very brief training. Studies by Verplanck, Cotton, and Collier (1952), Verplanck, Collier, and Cotton (1953), and by Verplanck and Cotton (1955) suggest that naive observers may confidently be used for dark adaptation studies employing the method of limits and a method of constant stimuli involving phenomenal report. The now-classic paper of Hecht and Shlaer (1938), describing their adaptometer, contains a dark adaptation curve (since widely reproduced) which is based upon data from "an intelligent subject who made the run for the first time, and who was completely inexperienced in making measurements of any kind."

A recent methodological study of the fluctuation limen technique in visual psychophysics by Taylor (1961) indicated that asymptotic values of threshold contrast were reached by at least the tenth experimental session, with no further drop occurring out to the thirtieth.

Blackwell (1953), in an investigation of the influence of various psychological sets upon thresholds obtained by use of the forced-choice method, presents practice curves which are in essential agreement with our own; the effect having disappeared by the fourth to seventh session. Hamilton (1958), in a study of transfer of discrimination training using the temporal forced-choice method, found that practice effects large enough to be distinguished from subsequent session-to-session variability were absent after the second or third practice session.[3]

The data from the present study corroborate the findings of several other experimenters, as is evident from the above. Additionally, since the experimental series was extended to fifty sessions, our results indicate no evidence for a secondary drop in threshold, at least out to the limits used. The absence of long-term effects, however, could not be established from previous reports, which typically extended to only ten sessions or less.

Quotidian variability, as shown in Figure 3, was found to be small, if indeed it exists at all. No attempt was made to establish the statistical significance of these differences, owing to the small number of input data and to the unequal distribution of sessions during the 17 weeks occupied by the study.

CONCLUSIONS

The time course of practice effects shown by initially naive observers during early training on a simple visual discrimination task was investigated using four subjects, each of whom completed fifty experimental sessions. The results indicate that early practice results in a lowering of the obtained threshold contrast values during the first few sessions only. Subsequent lowering of

---

3. An important finding in the Hamilton study deserves comment here. In investigating the extent of transfer of training from one visual task to another, he found that transfer was maximal when the initial practice sessions had involved a relatively "impoverished" target situation, and minimal when the initial sessions involved a phenomenally "richer" one. The clear implication is that naive observers who are to receive training with the idea that they will subsequently serve in a wide variety of experimental situations, should be trained on a difficult task rather than on an easy one.

threshold, beyond the fifth session, if present, was so small as to be obscured by session-to-session variability. It may be concluded on the basis of these results that observer training beyond about five sessions is unnecessary, at least for stimulus situations similar to ours and with the temporal forced-choice method of psychophysics. Retraining on novel tasks, shown by Hamilton (1958) to be dependent upon the character of the antecedent task, may be expected to require shorter, but never longer, series of sessions. Newly hired observers should, if time permits, be trained by use of stimulus conditions which are relatively difficult or "impoverished" in order to minimize or perhaps eliminate retraining on a different task. On the other hand, it may be seen that observers may be secured for short-term service with confidence that their initial training period need not be a protracted one, and that their data are likely to be acceptable after about five practice sessions. While this criterion for the completion of training may well vary with the nature of the psychophysical method used, it is unlikely (see Hamilton) to be dependent upon the nature of the stimulus conditions over a wide range of visual detection tasks.

REFERENCES

BLACKWELL, H. R., The influence of data collection procedures upon psychophysical measurement of two sensory functions, J. Exp. Psychol., 44, 306-315, (1952).

BLACKWELL, H. R., Psychophysical thresholds: Experimental studies of methods of measurement, Univ. of Michigan Press, Engineering Research Institute, Bull. No. 36, pp. 227, (1953).

BLACKWELL, H. R., PRITCHARD, B. S., and OHMART, J. G., Automatic apparatus for stimulus presentation and recording in visual threshold experiments, J. Opt. Soc. Am., 44, 322-326, (1954).

GIBSON, E. J., Improvement in perceptual judgments as a function of controlled practice or training, Psychol. Bull., 50, 401-431, (1953).

HAMILTON, C. E., The effects of practice on the visual-detection thresholds of naive observers, The University of Michigan, Proj. MICHIGAN Report 2144-321-T, pp. 9, (1958).

HECT, S. and SHLAER, S., An adaptometer for measuring human dark adaptation, J. Opt. Soc., Am., 28, 269-275, (1938).

RICHARDSON, W. H., An adaptation of the method of probit analysis to psychophysical threshold data, University of California, Visibility Laboratory, U.S.N. BuShips Contract NObs-72092, SIO Ref. 60-47, (1960).

RICHARDSON, W. H. and TAYLOR, J. H., A fractile analytic technique for reduction of psychophysical data by digital computer, (1962) (in preparation.)

TAYLOR, J. H., An experimental evaluation of the fluctuation limen as indicator of visual performance: Interim Report I, U.S.N. BuShips Contract NObs-72039, Task 6, Report No. 6-3, (1961).

VERPLANCK, W. S. and COTTON, J. W., The dependence of frequencies of seeing on procedural variables: I. Direction and length of series of intensity-ordered stimuli, J. Gen. Psychol., 53, 37-47, (1955).

VERPLANCK, W. S., COLLIER, G. H., and COTTON, J. W., Nonindependence of successive responses in measurements of the visual threshold, J. Exp. Psychol., 44, 273-282, (1952).

VERPLANCK, W. S., COTTON, J. W., and COLLIER, G. H., Previous training as a determinant of response dependency at the threshold, J. Exp. Psychol., 46, 10-14, (1953).